2003 Study of Bat Roosts
John Day Fossil Beds National Monument

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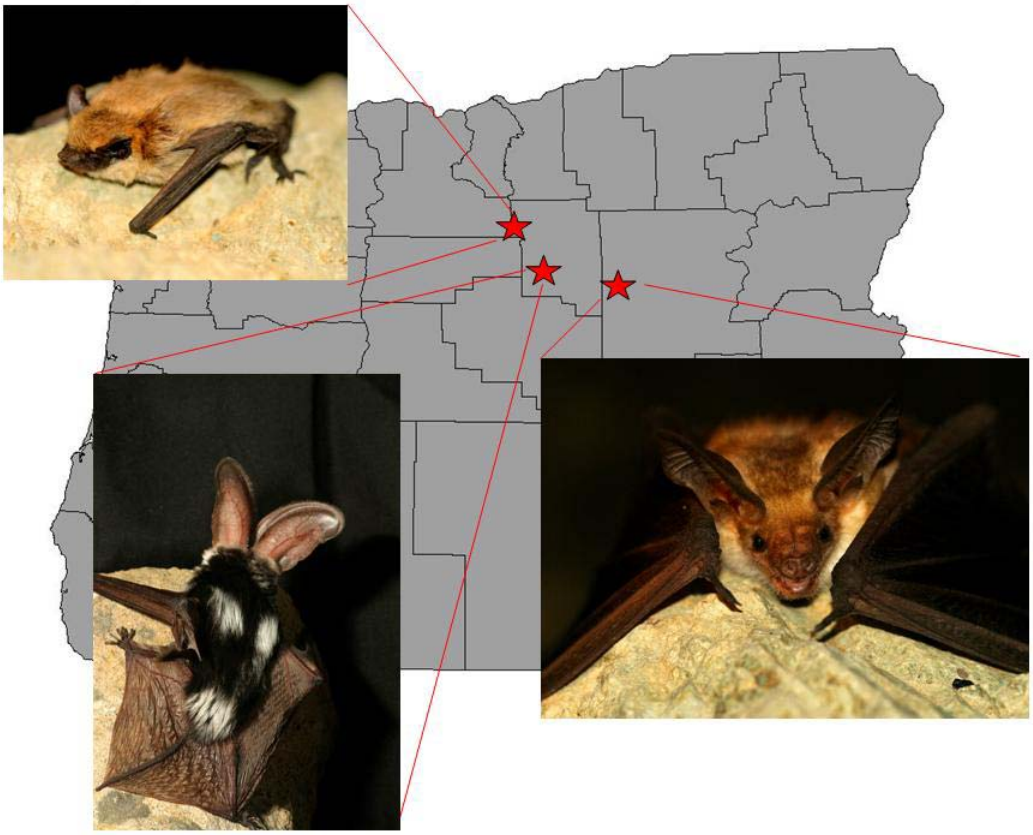

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Executive Summary

The 2003 study of bat roosts in the John Day Fossil Beds National Monument supplemented ongoing vertebrate inventory information and developed significant new information on the roosting and foraging ecology of the pallid bat, western small-footed myotis, and the spotted bat in the lower John Day River valley. The University of Idaho Department of Fish and Wildlife Resources conducted the study under a cooperative agreement with the Pacific Northwest Cooperative Ecosystem Studies Unit. The primary goal of the study was to determine the location, size, and physical characteristics of maternity colonies for four bat species of concern in and adjacent to the monument. The four target species were the pallid bat, Townsend's big-eared bat, western small-footed myotis, and the silver-haired bat. Each of these species are listed by state and federal agencies as species of concern. Additional goals included the collection of information on the foraging behavior of the western small-footed myotis and the spotted bat.

Radio transmitters were attached to 10 female pallid bats, 9 female small-footed myotis, 7 silver-haired bats, and 2 spotted bats. Townsend's big-eared bats were difficult to capture and no transmitters were attached to individuals of that species. Forty-five pallid bat day roosts and 52 small-footed myotis day roosts were located during the study. Silver-haired bats and spotted bats were difficult to track and likely were transient through the area. Only one male silver-haired bat remained in the area for 1 week and roosted in the top of a tall cliff complex. Pallid bats roosted in the largest south-facing cliff complexes available. Small-footed myotis roosted in cliffs and rock outcrops, but were less selective about roost structures. Pallid bat roosts were significantly taller than myotis roosts and were closer to capture locations. Small-footed myotis traveled up to 12 km between roosts and foraging areas. Both species exhibited strong fidelity to roost areas but switched roosts within areas frequently. Small-footed myotis showed strong fidelity to foraging areas located along agricultural fields and riparian areas. Pallid bats roosted in large maternity colonies of 22-120 bats and emerged from roosts after dark. Small-footed myotis roosted alone or in small clusters and emerged quickly after sunset.

The combination of telemetry results and capture results from 2 years of intensive mist-netting suggest some important patterns of bat use in the John Day valley. The high proportion of captures represented by pallid bats, small-footed myotis, and western pipistrelles, and the large number of spotted bat observations made from the species' audible echolocation calls present a picture of the bat community that is particularly representative of the dry, rocky habitat found in the John Day valley. The low proportion of forest-dwelling bats captured during the study, and the fact that most of those individuals were males or juveniles, suggests that the low elevation regions of the John Day valley are used primarily by these species as migratory corridors for transient bats moving between summer and winter locations and for dispersal of juvenile bats. Long-term monitoring of roosts and foraging areas are recommended and discussed. Optimal roosting structures for pallid bats in the monument are probably limited to the large, frequently visited features such as the Palisades.

I. Introduction

This report summarizes the results of the 2003 study of bat roosts in the John Day Fossil Beds National Monument (JODA). Information gained during bat capture and telemetry efforts in JODA on pallid bat (*Antrozous pallidus*) and western small-footed myotis (*Myotis ciliolabrum*) day roosts and foraging and commuting behavior of the small-footed myotis are presented. Limited information gained on silver-haired bats (*Lasionycteris noctivagans*) and spotted bats (*Euderma maculatum*) from telemetry efforts are also included as are detailed species accounts of all 14 bat species that occur in the lower John Day valley.

The University of Idaho Department of Fish and Wildlife Resources conducted the 2003 bat roost study under a cooperative agreement with the Pacific Northwest Cooperative Ecosystem Studies Unit. The study was designed to supplement ongoing vertebrate inventory and monitoring efforts in the monument by the National Park Service (NPS) Upper Columbia Basin Network (UCBN). The NPS servicewide inventory and monitoring (I & M) program was initiated in 1999 and has provided funding through the Natural Resource Challenge to complete basic biological inventories and to develop a long-term ecological monitoring program in JODA. Prior to this study, bat inventory activities in the monument were limited to sampling of foraging and drinking sites with mist nets and ultrasonic detection systems (see Rodhouse et al. 2004, unpublished report). While these activities fulfilled standard inventory goals by providing species composition and some habitat use information, a lack of knowledge about roosts constrained the ability of monument staff to adequately address the conservation needs of local bat populations. Information from this study can be used to guide future management and monitoring activities in the monument.

Roosts, especially those used by maternity colonies, are critical to the reproduction and survival of North American bats (Hill and Smith 1984, O'Shea and Bogan 2003). For certain species of bats, including the Townsend's big-eared bat and the pallid bat, a single large summer maternity colony or winter hibernacula can contain a disproportionate percentage of a regional population (Kunz and Martin 1982, Hill and Smith 1984, Betts 1997, Verts and Carraway 1998). The loss of one of these sites may therefore contribute disproportionately to regional population decline (O'Shea and Bogan 2003). Successful conservation of regional bat populations depends on the ability of resource managers to locate, monitor, and reduce disturbance at known roosts and to protect additional suitable habitat. Disturbances to roosts on the monument may be caused by recreation, paleontological activities, or restoration activities such as prescribed burning. Foraging habitat may also be vulnerable to various types of land use and degraded water quality. Consistent monitoring over time is required to adequately detect these changes and this project has contributed important baseline information for future monitoring.

The primary goal of this roost study was to determine the location, size, and physical characteristics of maternity colonies for four bat species of concern in and adjacent to the monument. The four target species were the pallid bat, Townsend's big-eared bat,

western small-footed myotis, and the silver-haired bat. Each of these species are listed by state and federal agencies as species of concern and a recent review of the species' status in Oregon has reconfirmed each as vulnerable to significant declines resulting from human disturbance and habitat loss (Verts and Carraway 1998, Csuti et al 2001, Oregon Natural Heritage Program 2001, Eric Scheuering, Oregon Natural Heritage Program, personal communication). In the case of the pallid bat and Townsend's big-eared bat, previous investigations in the vicinity of the monument had demonstrated that maternity colonies were present and that further research was warranted in order to provide the monument with adequate information for future management and monitoring (Perkins 1987, Lewis 1993a, 1993b, 1994). Lewis (1993a, 1993b, 1994) had conducted research on pallid bats along the John Day River several miles west of the Clarno Unit of the monument but no roost locations were available from that study to relocate. Perkins (1987; Oregon Natural Heritage Program, unpublished data) performed hibernacula counts at a cave location near the Sheep Rock Unit of the monument in 1985 and 1989 and demonstrated that colony size may have been significantly reduced in 1989. Parker et al. (1964) also noted a change in bat use in the cave between the early 1900's and 1964. Captures of pregnant and lactating female small-footed myotis during 2002 inventory work suggested that a breeding population was present in the monument but very little additional information was available on the species' roosting ecology (Verts and Carraway 1998, Holloway and Barclay 2001). Captures of several female silver-haired bats in June of 2002 in the Clarno Unit also prompted inclusion of that species into the study so that the importance of juniper and deciduous riparian trees as roosts could be evaluated. Substantial research on the species in higher elevation coniferous forests had shown a clear association with large snags, but no information was available on patterns of roosts use in lower elevation sites (Campbell et. al. 1996, Betts 1998, Verts and Carraway 1998).

In addition to the roost research, an important secondary goal of the project was to gather information on the foraging and commuting behavior of the small-footed myotis and the spotted bat. Because of the paucity of life history information available on both of these arid land bats, this project provided an excellent opportunity to contribute important new information on these species. As was the case with the small-footed myotis, results from inventory work in 2002 had provided substantial evidence that the lower John Day valley provided unusually important habitat for the spotted bat. This discovery was particularly noteworthy because of the rarity of this species in Oregon (Verts and Carraway 1998). The species is considered vulnerable to decline by the Oregon Natural Heritage Program (Eric Scheuering, Oregon Natural Heritage Program, personal communication). A more thorough discussion on information generated from this project for the spotted bat will be available in Rodhouse et al. (2005, *in press*). While much of the available research literature on bats in the Pacific Northwest focuses on roosts, foraging and commuting information can be important for developing more comprehensive conservation strategies, as has recently been suggested by Ball (2002).

II. Study Area

The John Day Fossil Beds National Monument is comprised of three separate units located in the John Day River valley of eastern Oregon. The monument was established in 1975 and congressional boundaries include a total of 14,014 acres. The monument consists of three separate units. Sheep Rock, located in western Grant County, is the largest unit and contains 8916 acres. The Sheep Rock Unit includes two small disjunct subunits, Cathedral Rock and Foree. The monument headquarters are located at the historic Cant Ranch in the Sheep Rock Unit. The two smaller units of the monument are the Clarno and Painted Hills Units. Both of these are located in Wheeler County and contain 1969 and 3129 acres, respectively. Ownership patterns adjacent to the monument consist of a mosaic of Bureau of Land Management (BLM), tribal, and private lands and this ownership pattern is very influential in the biological diversity of the monument. The John Day Fossil Beds lies within a growing matrix of land dedicated to conservation of natural resources. The Confederated Tribes of Warm Springs own and manage the Pine Creek Ranch, which contains over 15,000 acres of land dedicated to fish and wildlife conservation adjacent to the Clarno Unit. This property contains important resources for bats, including Pine Creek, a major tributary of the John Day River, and a significant amount of work related to this project occurred on the ranch.

The three units of the John Day Fossil Beds are located along the main stem of the John Day River and three major tributaries; Pine Creek, Bridge Creek, and Rock Creek. Elevation in the monument ranges from approximately 1380 feet in the Clarno Unit, to a high point of approximately 4114 feet in the eastern boundary of the Sheep Rock Unit. The majority of the monument, including much of the Painted Hills, lies within 2000 to 2500 feet. The extensive rain shadow cast by the Cascade Mountains and Ochoco mountains to the west dominates the climate of the monument. Winters are cool and dry and summers are hot and dry. Rainfall patterns are variable in the region but most falls in the early spring and late fall (Oregon Climate Service 2003). Thirty-year averages available from a weather station near the town of Dayville, 8 miles up the John Day River from the Sheep Rock Unit, show that total annual precipitation is approximately 11 inches (Oregon Climate Service 2003). Records from Mitchell, near the Painted Hills Unit, are similar, and the Clarno Unit may receive even less precipitation because of its low elevation (Oregon Climate Service 2003). Data from the rain gauge at the monument headquarters indicate that rainfall there has been below average in recent years. The total precipitation in the Sheep Rock Unit for 2001 and 2002 was 10 and 6.5 inches, respectively (Ken Hyde, JODA, personal communication). In 2003, precipitation was higher, with a total of 11.5 inches recorded at Sheep Rock (Ken Hyde, JODA, personal communication). Snowfall represents a significant proportion of the winter precipitation but snowpack is ephemeral and rarely lasts more than a few days. Thirty-year January and July mean temperatures from Dayville are 36 and 71 degrees Fahrenheit, respectively (Oregon Climate Service 2003). Thirty-year mean January and July maximum and minimum temperatures are 45 and 90 degrees and 27 and 52 degrees, respectively (Oregon Climate Service 2003). It is important to note that winter and summer

temperature extremes frequently drop below zero in the winter and above 100 degrees in the summer.

All three units lie within the Blue Mountain physiographic province and the John Day ecological province (Franklin and Dyrness 1988, Anderson et. al. 1998). These designations are useful in that they indicate some geological and ecological consistencies between all three units. The area is rugged, with steeply dissected hills and cliffs (Anderson et. al. 1998). The soils of this region are largely volcanic clays and tuffs that have a profound influence on the vegetation. Higher portions of the monument are capped with ancient flood basalts and lithosols have formed in these areas. Much of the monument, especially in the Painted Hills Unit, contain bare and sparsely vegetated slopes of clays. Juniper-sagebrush steppe vegetation dominates most of the monument (Franklin and Dyrness 1988). Western juniper (*Juniperus occidentalis*), big sagebrush (*Artemisia tridentata*), and bluebunch wheatgrass (*Agropyron spicatum*) are the characteristic plants of that vegetation type (Franklin and Dyrness 1988). In many areas, dense stands of juniper trees create juniper woodland, with a much reduced shrub and grass component. There are extensive riparian habitats along the John Day River in the Sheep Rock Unit dominated by coyote willow (*Salix exigua*), black cottonwood (*Populus trichocarpa*), and a variety of sedges, rushes, and grasses. There is a unique riparian vegetation type along Rock Creek that is dominated by mountain alder (*Alnus incana*). Other wetland habitats include small seeps and springs as well as one palustrine wetland found in the southern end of the Sheep Rock Unit near Picture Gorge. Other unique vegetation types include alkaline playas with greasewood (*Sarcobatus vermiculatus*) and shadscale (*Atriplex confertifolia*) that resembles vegetation of the Great Basin. Mountain mahogany (*Cercocarpus ledifolia*) stands are found extensively along rimrock and cliffs of the Sheep Rock Unit. Lithosols on upper elevation slopes and ridges support a unique vegetation type characterized by stiff sagebrush (*Artemisia rigida*), Idaho fescue (*Festuca idahoensis*), and a variety of forbs such as pincushion phlox (*Phlox hoodii*), lomatiums (*Lomatium spp*.), and desert buckwheat (*Eriogonum spp*.). Two natural research areas in the Sheep Rock Unit contain lithosol habitats where the unique hedgehog cactus (*Pediocactus simpsoni*) is found.

In all habitats in the monument, the western juniper and a variety of introduced weeds are spreading and having a pronounced effect on those habitats (Anderson et. al. 1998). A significant effort by the monument is underway to control these species through mechanical and chemical removal and the use of prescribed fire (Ken Hyde, JODA, personal communication). Fire, including natural ignitions, is an important ecological mechanism affecting vegetation in the monument and the vertebrate communities that it supports. Historic vegetation conditions in the park are believed to have contained much more extensive perennial grasslands with patchy stands of shrubs and juniper (Buhl 1975; Campbell 1976; 49th Congress House of Rep., ex. Doc. No. 131, 1886; Anderson et al. 1998). Grazing and fire suppression are believed to have caused a dramatic increase in the densities of woody vegetation at the expense of grasses and forbs (Anderson et al. 1998). Natural ignition fires in the Clarno Unit during the 1990's have greatly reduced the amount of juniper and sagebrush stands and increased the amount of native perennial and introduced annual grasses. Natural fires are less frequent in the Painted Hills and

Sheep Rock Units and prescribed fires are being used in an attempt to reduce the amount of juniper and sagebrush (Ken Hyde, JODA, personal communication). While both the invasion of weedy species and activities attempting to control them are presumably impacting bats in the area, the extent and significance of this impact remains unknown.

III. Methods

The methods utilized in the 2003 study of bat roosts generally followed those laid out in Kunz (1988) and the British Columbia Resources Inventory Committee Inventory Methods for Bats (1998). Telemetry specific methodology also followed methods presented in a number of prior studies from the Pacific Northwest using telemetry equipment (i.e. Betts 1998, Waldien et. al. 2000). All capture and handling procedures were consistent with the Ad Hoc Committee on Acceptable Field Methods in Mammalogy (1987) and were approved by the University of Idaho Institutional Animal Care and Use Committee. Universal Transverse Mercator (UTM) locations given in this report were collected using Garmin 12-channel Etrex hand-held GPS units (Garmin International, Inc, Olathe, KS, USA). X and y coordinates (Eastings and Northings) are accurate within 10 meters. No accuracy estimate is available for elevation data provided by the GPS unit. UTM locations are in zone 10 for Clarno and Painted Hills, and zone 11 for Sheep Rock. The North American Datum of 1927 (NAD 27) was used as the horizontal datum for all locations.

Scientific and common names used in this report follow the Integrated Taxonomic Information System (ITIS). The ITIS follows closely the USGS Biological Resource Division's unpublished and expanded update of the 1987 Checklist of Vertebrates of the United States, the U.S. Territories, and Canada (ITIS 2003). With the exception of the reassignment of *Corynorhinus townsendii* to the Townsend's big-eared bat (formerly *Plecotus townsendii*), no other recent changes in the taxonomic status of Pacific Northwest bats have been made.

A. Captures

Mist netting was the only bat capture technique used to obtain target species for telemetry work, although some additional information presented in this report was obtained during monument species inventory efforts using a hand-held "H" net (see Waldien and Hayes 1999). Mist nets designed specifically for bats (i.e. 38mm mesh size with reduced bag) were placed over water and in bat flyways. A range of net lengths (2.6, 6, 9, and 12 meters) was used in different arrays in response to topographic and strategic considerations. Nets were opened at sunset and kept open until midnight or later. On some nights nets were closed early in response to low bat activity, inclement weather, or other logistical considerations. Productive sites were revisited multiple times in order to detect seasonal and nightly variation in species presence. Ancillary data collected with bat captures included time of capture, date, location, weather, time of sunset, age, sex, reproductive condition, and forearm length. Tissue biopsies were collected from Yuma myotis (*Myotis ymanensis*) and little brown myotis (*Myotis lucifugus*) in cooperation with the Oregon Bat Grid project and Portland State University (PSU). Genetic analysis conducted at PSU confirmed species identification of these two easily confused cryptic species and allowed for paired morphological and voucher echolocation calls to be analyzed and aid in improved field identification.

B. Acoustic Tools

The Anabat bat detection system (Titley Electronics, Ballina, NSW, Australia; Corben Scientific, Rohnert Park, CA, USA) was used to record and analyze the ultrasonic calls emitted by bats released after capture and processing. This was done in part to contribute to the growing library of regional bat calls being developed during park inventory activities in the Upper Columbia Basin Network. Calls were also collected from some instrumented bats as a crosschecking exercise to help ensure that transmitters were not causing undue flight interference or other behavioral changes. Recording of free-flying bats was conducted intermittently throughout the study, and was conducted extensively in 2002 during species inventory efforts in the monument and some of the information gathered from these recording sessions is included in this report. The Anabat system used during the study consisted of an Anabat II bat detector, type 6 standard Zero-Crossings Analysis Interface Module, an IBM-compatible laptop, Anabat 6 software, and Analook software. A 12-volt 100-watt handheld spotlight was used during recording sessions to illuminate flying bats and provide visual cues to aid in species identification.

C. Telemetry

A total of 28 radio transmitters were attached to 10 adult female pallid bats, 9 adult female western small-footed myotis, 5 male and 2 female silver-haired bats, and 2 male spotted bats. LB-2 model transmitters (Holohil Systems, Carp, Ontario, Canada) weighing 0.46 g were used on all species except the small-footed myotis and represented less than 6% of the body weight of instrumented bats. LB-2N model transmitters weighing 0.35 g were used on all small-footed myotis and represented less than 8% of the body weight of instrumented bats. We followed information contained in Aldridge and Brigham (1988), Brigham et al. (1997), Waldien et al. (2000), and Kurta and Murray (2002) to determine 8% as an acceptable upper limit for our project, and all myotis weighing less than 4.5 g were excluded from the study. Bats weighing close to the 4.5 g limit were held for 30 minutes and reweighed before processing to allow for stomach contents and fecal material to be eliminated. No pregnant bats were instrumented except for pallid bats, which are so large that the extra weight from the transmitter is negligible. A number of adult female small-footed myotis were released without instrumentation because of pregnancy and weight concerns. Transmitters were attached to a small trimmed portion of the intra-scapular region of bats using Skin-Bond (Smith and Nephew United, Largo, FL, USA). All bats were released within 1hour of capture.

Telemetry receivers (model TRX 1000-S, Wildlife Materials, Inc., Carbondale, IL, USA), unidirectional vehicle roof antennas, and 5-element hand-held directional yagi antennas were used to track bats to roosts and to track small-footed myotis to foraging areas. Signals were also monitored during exit counts to confirm bat departure times. Foraging small-footed myotis were tracked by directly honing in on bats and by monitoring the movement of the signal and quality of signal attenuation. We found it unnecessary to triangulate bat locations at night and were often able to make visual contact with foraging bats using a spotlight to illuminate the transmitter antenna.

Bat emergence times and estimates of colony size were made at dusk by quietly watching roost openings and monitoring telemetry receivers. Exit counts provided confirmation of the exact roost opening, although bats were often visible or heard producing social calls in roosts during daytime reconnaissance. Digital photographs were made of all roosts and roost height, aspect, and detailed descriptions of roost locations were recorded. Roost heights were obtained by measuring with reel tape and by estimating to the nearest 1 meter for taller cliff roosts. Attempts were made to use a clinometer, but the rugged terrain and height of many cliffs made this difficult.

IV. Results

A. Capture Results

Because of both the inventory and telemetry work conducted in JODA, a large amount of capture information was collected on bats in the monument during 2002 and 2003. All 14 species expected to occur along the John Day River were captured during 71 mist net sessions from May 30 to September 9, 2002 and June 16 to October 3, 2003. Total mist net effort during 2002 and 2003 included 8825 meters of net employed over 329 hours. Additional miscellaneous captures were made on several occasions using a hand-held "H" net. In total, 604 individual bats were captured during the study. Tables 1 and 2 present all of the capture data collected during this project. The capture locations with the highest species richness were the reach of Pine Creek adjacent to the Palisades in the Clarno Unit and the Rock Creek impoundment in the Sheep Rock Unit. Along Pine Creek, 12 species of bats were captured and the spotted bat was frequently heard flying overhead, indicating that at least 13 species of bats occur along Pine Creek. The one species not encountered there, the fringed myotis (*Myotis thysanodes*), was captured along Rock Creek and the main stem of the John Day River on a few occasions and probably does periodically use the Pine Creek corridor. Along Rock Creek, 9 species of bats were captured underneath the closed mountain alder canopy. High species richness was also observed along certain stretches of the John Day River adjacent to Goose Rock and Cathedral Rock and differences in total species captured there compared with the tributaries likely has more to do with the degree of open water and the associated ability for bats to avoid capture than with any real differences in species presence.

The most abundant species captured during the two seasons of work was the Yuma myotis, representing well over 25% of total captures. Relative abundance of this species may be as high as 35%, but this species is easily confused with the little brown myotis and these two species were not separately identified during early summer capture sessions in 2002. Voucher calls were recorded with the Anabat system and tissue samples were collected that enabled positive identification of these two species after July 2002. Other species with notable abundances were the pallid bat, western small-footed myotis and the western pipistrelle (*Pipistrellus hesperus*), with 15%, 8%, and 8% of total captures, respectively. The high proportion of Townsend's big-eared bat captures (7%) are artificially inflated because of the concentration of this species at one cave location near Sheep Rock mist netted in the fall of 2002 and 2003. This species is otherwise rarely captured and only one individual was captured along Pine Creek in 2002.

Capture results at the cave near Sheep Rock suggest that it may be an "autumn swarming" site where bats congregate to breed before hibernation. Captured males of several species, including Townsend's big-eared bats, pallid bats, and western small-footed myotis, showed swelling of the epididymes, a condition indicating breeding readiness. Total captures at the cave in September 2003 exceeded 25 bats and many bats were missed because of the net arrangement. Only 5 bats were captured in early August of 2002, suggesting that bat activity may increase in the fall. The captures of the spotted

bat at Clarno and at the cave near Sheep Rock (see Tables 1 and 2) were particularly noteworthy, considering the difficulty reported in capturing this species (Navo et al. 1992, Gitzen et al. 2001). Capture results under-represent the relative abundance of this species in the monument. Spotted bats produce audible echolocation calls and the species was frequently heard flying high overhead during the project. Over 100 spotted bat passes were recorded during the project and the species was encountered regularly foraging along Pine Creek in the Clarno Unit. The species was encountered infrequently in the Painted Hills and Sheep Rock Units (see Rodhouse et al. 2005, *in press*). Several forest-dwelling species, including the long-eared myotis (*Myotis evotis*), the California myotis (*Myotis californicus*), and the long-legged myotis (*Myotis volans*) were rarely captured during the project. Captures of the hoary bat, another species frequently described as a forest bat, included 6 females, occurred more frequently than expected. Figures 1-3 show the locations of mist net and "H" net capture sessions and tables 1 and 2 summarizes the results of those capture sessions. It is important to note that capture site topography and variability in species foraging behavior greatly bias species richness and abundance calculated from mist net results and care should be taken when interpreting these results.

B. Telemetry

1. Pallid Bat

Ten adult female pallid bats were fitted with transmitters and tracked to 45 day roosts in 2003. Reuse of roosts occurred on 24 occasions, yielding 21 discrete roost locations. Five individuals were tracked in the Sheep Rock Unit, 3 were tracked in the Clarno Unit, and 2 were tracked in the Palisades Unit. Table 3 presents the location, height, and aspect data for pallid bats roosts. Figures 4-6 show pallid bat roosts located during the study. Table 5 shows the summary statistics for pallid bat roost characteristics. Table 7 presents a comparison of selected pallid bat and small-footed myotis roost characteristics. All roosts but one were located in narrow crevices in large cliff complexes, and those located during the pup-rearing season (June-August) were located close to capture locations in the largest cliffs available. One roost was located on the bole of a large Russian olive tree (*Eleagnus angustifolia*) along Bridge Creek. This roost is an outlier in the data and probably represents a negative reaction by the bat to the previous nights capture and processing. The bat was relocated in the colonial roost on the cliff band the following day. This was the only indication of altered behavior resulting from capture and processing during the study.

The mean distance from capture location to roost for pregnant and lactating pallid bats was 0.41 km. Late season roosts (i.e. post-lactating) were located 10 km from the capture site in Sheep Rock. In Sheep Rock, pallid bats were captured along the John Day River adjacent to the large "Goose Rock" feature, a cliff band of ancient conglomerate rock exceeding 65 meters in height. No other cliff features of that height and topographic prominence are found near the capture location and all roosts were located there except during the late, post-lactating period when maternity colonies appear to break up. Table 3 shows the list of roosts and the dates of occupation. In the Clarno Unit, pallid bats were

captured along Pine Creek in front of the "Palisades" cliff complex and at the "2nd" stock pond located behind the Palisades in Hancock Canyon (see figure 4). All pallid bat roosts were located in the open cliff faces of the Palisades. The Palisades feature is a large cliff band of ancient volcanic flood "lahar" material also reaching 60 meters or more in height in several places. In the Painted Hills Unit, the first instrumented pallid bat was captured along Bridge Creek below a prominent band of ignimbrite, or "welded" volcanic tuff, located on the southeast side of Carroll Rim overlooking the park. The cliff band is itself only 10 meters in height, but is prominently positioned on the rim and presents the largest available cliff complex near the capture location. The first instrumented pallid bat was tracked to a series of roosts along the cliff and a second instrumented pallid bat was captured in a net positioned along the rim of the cliff. This bat also used several of the same roosts along the cliff.

Pallid bat roost heights during pup-rearing season ranged in height from 2.5-62 m and averaged 25 m. The mean aspect of all roost openings was 202 degrees. Estimates of colony sizes during pup-rearing averaged 54 bats and ranged from 22-120 bats. Late season roosts were occupied by only 2 bats, presumably a mother and pup pair. Roosts were switched frequently and the average occupation of a roost during pup-rearing was 2 days and ranged from 1-9 days. Late season roosts were never occupied more than one day. However, considerable fidelity to roost areas was observed, and bats moved among several crevices within the same general area of a cliff. On several occasions during pup rearing, entire pallid bat maternity colonies apparently moved together from one roost to another. Evidence for these phenomena was gathered when exit counts were conducted simultaneously at the previous day roost as well as the currently occupied roost. Emergence times of instrumented bats, as well as for roost mates, usually occurred after dark. Average emergence occurred 49 minutes after civil sunset and ranged from 31-74 minutes. Emergences for some of the larger colonies frequently lasted for 30 minutes or more.

2. Western Small-footed Myotis

Nine adult female western small-footed myotis were fitted with transmitters and tracked to 52 day roosts in 2003. Table 4 presents the location, height, and aspect data for small-footed myotis roosts. Figure 7 shows the location of roosts in the Clarno Basin. Summary statistics of small-footed myotis roosts are presented in Table 6. Comparisons of selected pallid bat and small-footed myotis roost characteristics are presented in Table 7. All 9 bats were tracked in the Clarno area, as no female small-footed myotis were captured in Sheep Rock and Painted Hills except at Officer's Cave in fall of 2003. A significant number of roosts were located in small side canyons of Pine Creek located outside the monument boundary on the Pine Creek Ranch. All roosts were located in narrow vertical or horizontal crevices in cliffs and rocky outcrops. One roost was located under a boulder on a steep, rocky slope. Roosts were switched frequently and only reused on 9 occasions, yielding 43 discrete roost locations (see Table 4). As with pallid bats, considerable fidelity to roosting areas was observed, however, and individual bats moved among a cluster of roosts within the same general cliff or outcrop complex.

While most pallid bat roosts were located on the face of cliffs, most small-footed myotis roosts were located off of large open faces in highly fractured outcrops. Roost heights were considerably smaller than those of pallid bats (p-value < 0.01, two-sample t-test; see Table 7). Heights for small-footed myotis roosts averaged 4.5 m and ranged from 0-25 m. Small-footed myotis roosts were also much farther from capture sites than those of pallid bats (p-value < 0.01, two-sample t-test). Average distances were 4.4 km and ranged from 0.3-10.5 km. Small-footed myotis roosted in small clusters or solitarily. Colony size averaged 2 bats, ranged from 1-15 bats, although the median colony size of 1bat may be a more appropriate summary statistic. The mean aspect of roosts was 216 degrees and ranged from 10-340 degrees. Emergence times were relatively early and differed significantly from those of pallid bats (p-value < 0.01, two-sample t-test). Mean emergence times for small-footed myotis was 25 minutes after civil sunset and ranged from 8-35 minutes.

Foraging observations were made on 38 nights during the study. Each of the bats were followed periodically at night as logistics permitted for 2-8 nights. Foraging small-footed myotis were observed traveling surprisingly long distances between roosting areas and foraging grounds. Mean distance to foraging areas was 6 km and ranged from 3-12 km. High fidelity was exhibited among all bats to particular foraging areas. Of 9 bats for which foraging and commuting observations were made, 6 were found foraging exclusively in a 2.5 km oval region of agricultural fields and riparian areas along the John Day River and the mouth of Pine Creek (see Figure 8). One bat was found foraging farther up river along the bank of the river on 2 nights, a second bat spent time in both the demarcated area and in agricultural fields north of Pine Creek, and one bat was followed up Pine Creek on one night, presumably to forage, but foraged in the primary demarcated oval in figure 8 on two other nights. No small-footed myotis were observed using night roosts, but lactating bats were observed returning to day roosts for short periods (i.e. 20 minutes), presumably to nurse and move pups to new roosts. After the pup-rearing period in August and September, bats were observed foraging continuously for 4 hours or more before returning to day roosts for the remainder of the night. Numerous visual observations were made of instrumented bats foraging with other mixed species groups of myotis. Bats foraged back and forth in small circuits 2-5 m over fields and low slopes and in and among small outcrops of rock adjacent to the same fields. Bats also occasionally foraged low over the river in a manner similar to that of Yuma myotis (Verts and Carraway 1998).

3. Silver-haired Bat

Seven transmitters were attached to five male and 2 female silver-haired bats in 2003. Surprisingly, no bats could be relocated except for the first male instrumented in late June. All other individuals presumably left the area. While it is possible that the bats remained in the area but were simply "missed", this is unlikely given the success at finding other species of bats in the area during the same period as well as the extensive search efforts made for several days following processing of each instrumented bat. The first instrumented male silver-haired bat used 2 different roosts in the top of the Palisades cliff complex on the Clarno Unit. This bat reused the second roost for 5 days before

disappearing. Exit counts confirmed that the bat was roosting alone and foraged nightly during that 6 day period.

4. Spotted Bat

Despite considerable effort, no spotted bats could be captured until the end of August 2003. Two other spotted bats were captured in September. Transmitters were attached to two male spotted bats captured at Clarno. Like the silver-haired bats, neither of these bats could be tracked to roosts. After searching for 4 days and nights, one bat was briefly encountered foraging approximately 8 km up river from the capture site, but could not be relocated again. The second bat was tracked up river for several hours after being released but was not relocated on subsequent days and nights. For additional information on distribution, foraging behavior, and capture results of the spotted bat in the John Day valley, see Rodhouse et al. (2005, *in press*).

5. Townsend's Big-eared Bat

Again, despite considerable effort, no Townsend's big-eared bats could be captured during the project until late season visits were made to the cave near Sheep Rock. A conclusion was made earlier in the project that attaching transmitters to female Townsend's bats from that cave would be relatively unproductive given the possibility that the cave would be the only day roost used during tracking. Also, the time required to do this was better allocated to the ongoing work with pallid bats and small-footed myotis.

V. Discussion

The information accumulated about bats in the John Day valley in 2002 and 2003 clearly suggests that the valley is an important regional resource for bats in the Pacific Northwest. High species diversity and the presence of breeding populations of several unique arid land bats of state and federal concern underscore this importance, as do the presence of transient species that apparently use the river canyon and its tributaries to move between higher elevation forested habitats and, in the case of silver-haired and hoary bats, more southerly winter destinations. While this study did not address the winter activity and hibernacula use in the valley, unpublished reports from winter inspections of the cave located near Sheep Rock indicate that the cave itself and perhaps other large geological features are important winter hibernacula (Perkins 1987, Parker et al. 1964). Capture results from 2002 and 2003 provide evidence that the cave may also be an important "autumn swarming" breeding site.

The high proportion of captures represented by pallid bats, small-footed myotis, and western pipistrelles, and the large number of spotted bat observations made from the species' audible echolocation calls present a picture of the bat community that is particularly representative of the dry, rocky habitat found in the John Day valley. The low proportion of forest-dwelling bats captured during the study, and the fact that most of those individuals were males or juveniles, suggests that the low elevation regions of the John Day valley are used primarily by these species as migratory corridors for transient bats moving between summer and winter locations and for dispersal of juvenile bats. In particular, the long-eared myotis, a species commonly captured in forested habitats throughout Oregon (see Ormsbee and Risdal 2004, unpublished data), is apparently quite rare in the area. Other species that fit into this "transient" category include the fringed myotis, long-legged myotis, and the California myotis. The silver-haired bat also fits into this category, and the results of the telemetry work on this species provide strong evidence that the silver-haired bat frequently moves through the area but females do not rear pups in the area. The hoary bat is another transient species of interest. This species is migratory and infrequently captured in the Pacific Northwest (Verts and Carraway 1998, Ormsbee and Risdal 2004, unpublished data). Females are particularly rare in the historic records for Oregon (Ormsbee and Risdal 2004, unpublished data). The John Day River valley appears to be an important migratory corridor for this species. Cryan (2003) presented a description of hoary bat migration based on museum records that is consistent with the capture data from this project.

While care must be taken not to interpret the telemetry results beyond an appropriate scope of inference, several noteworthy patterns are suggested. In the case of the pallid bat, clearly the large prominent south-facing cliffs close to water are the most important locations for the persistence of large maternity colonies in the region. This is consistent with the results reported by Lewis (1993a, 1993b, 1994) from her work in the Clarno area. While cliffs appear to be in abundant supply throughout the monument, features such as Goose Rock in the Sheep Rock Unit and the Palisades and associated lahar features farther up Pine Creek are probably uniquely situated for pup-rearing use by pallid bats and many other species. The ignimbrite cliff band on Carroll Rim overlooking

Bridge Creek in the Painted Hills Unit is probably even more important, in terms of limited roosting availability. All other large cliffs near the Painted Hills Unit are found along the base of Sutton Mountain, located several kilometers away from the creek, a distance several times beyond the farthest distance recorded during our study. The Palisades, Goose Rock, and Carroll Rim cliff complexes likely serve as important regional population sources for this species. The species is apparently quite rare in many parts of Oregon, even more so in Washington, and has shown declines in other parts of its range (Sarrell and McGuiness 1993, O'Shea and Vaughan 1999, and Ormsbee and Risdal 2004, unpublished data). Cliff dwelling colonies of pallid bats in one Arizona site experiencing increased recreational use have shown potentially steep declines over a 20 year period (O'Shea and Vaughan 1999). Cave tours have also been shown to impact bats (Mann et al. 2002). Visitation to the Palisades is increasing and expected to continue to increase (John Lainge, JODA Ranger, personal communication). Monitoring of roosts in the key cliff complexes in JODA will be an important step in effectively documenting and managing stressors to this species. In 2004, pallid bat roosts in the palisades were revisited and exit counts were performed, providing an example of how a monitoring strategy could be designed (OMSI Bat Team 2004, unpublished report).

In the case of the western small-footed myotis, telemetry results also showed that the Palisades cliff complex is an important resource for non-colonial species. The use of the palisades by one male silver-haired bat provides further evidence for this, as does the anecdotal observations of many western pipistrelles and myotis emerging from crevices in the cliffs during exit count activities. However, the small-footed myotis also utilized a broad array of rocky outcrops. These features are widely available throughout the Clarno Basin and roosts are probably not a limiting factor for this species. This type of roosting strategy (i.e. low colony size, frequent roost switching, high roost availability) has been described as "over-dispersed", and is shared by many species of western bats that use crevices and cavities (Bogan et al. 2003). Frequent, usually daily, roost switching was observed among small-footed myotis during our study, a behavior associated with high roost availability (Lewis 1995, Bogan et al. 2003). This behavior poses considerable challenges to roost monitoring, and this species will probably be better addressed through acoustic and capture monitoring techniques along riparian areas. Observations of foraging small-footed myotis demonstrated considerable fidelity to a cluster of agricultural fields and adjacent riparian areas below the confluence of Pine Creek and the John Day River. There is an important energetic trade-off between the quality of a roost and the distance of a roost to foraging areas (Lewis 1995, Shiel et al. 1999). That these small bats regularly traveled many kilometers nightly indicates the importance of this site for foraging. This fidelity exemplifies the impact that land use and land cover changes, including pesticide use and alteration of vegetation cover, could have on bat communities in the monument (Pierson 1998). Acoustic and capture monitoring of foraging areas could provide an important index of change in bat communities resulting from degraded foraging habitat.

V. Species Accounts

This section gives a brief description of each bat species occurring in the John Day Fossil Beds National Monument. Species names are followed by a series of codes based on those in use by the National Park Service NPSpecies database. The first code indicates park status, followed by an indication of the monument units in which the species has been observed as well as species abundance and species residency. The information presented here is primarily based on 2002-2003 results and is not necessarily comprehensive and should be interpreted carefully. Abundance estimates were not based on any quantitative population estimate but rather from capture data, a highly biased technique. A key to the codes used after the species names is located on the following page.

Park Status

- **(P) Present:**
  Species occurrence in park is documented and assumed to be extant.
- **(H) Historic:**
  Species historical occurrence in the park is documented, but recent investigations indicate that the species is now probably absent.
- **(PP) Probably Present:**
  Park is within species range and contains appropriate habitat. Documented occurrences of the species in the adjoining region of the park give reason to suspect that it probably occurs within the park. The degree of probability may vary within this category, including species that range from common to rare.
- **(E) Encroaching**
  The species is not documented in the park, but is documented as being adjacent to the park and has potential to occur in the park.
- **(U) Unexpected:**
  Included for the park based on weak (unconfirmed) record or no evidence, giving minimal indication of the species occurrence in the park.
- **(FR) False Report:**
  Species previously reported to occur within the park, but current evidence indicates that the report was based on a misidentification, a taxonomic concept no longer accepted, or some other similar problem of interpretation.

Monument Unit

- **(SR) Sheep Rock**
- **(PH) Painted Hills**
- **(CL) Clarno**

Species Abundance

- **(A) Abundant:**
  Animals: May be seen daily, in suitable habitat and season, and counted in relatively large numbers.
  Plants: Large number of individuals; wide ecological amplitude or occurring in habitats covering a large portion of the park.
- **(C) Common:**
  Animals: May be seen daily, in suitable habitat and season, but not in large numbers.
  Plants: Large numbers of individuals predictably occurring in commonly encountered habitats but not those covering a large portion of the park.
- **(U) Uncommon:**
  Animals: Likely to be seen monthly in appropriate season/habitat. May be locally common.
  Plants: Few to moderate numbers of individuals; occurring either sporadically in commonly encountered habitats or in uncommon habitats.
- **(R) Rare:**
  Animals: Present, but usually seen only a few times each year.
  Plants: Few individuals, usually restricted to small areas of rare habitat.
- **(O) Occasional:**
  Occurs in the park at least once every few years, but not necessarily every year. Applicable to animals only.
- **(UNK) Unknown:**
  Abundance unknown.

Residency

- **(B) Breeder**:
  Population reproduces in the park.
- **(R) Resident:**
  A significant population is maintained in the park for more than two months each year, but it is not known to breed there.
- **(M) Migratory:**
  Migratory species that occurs in park approximately two months or less each year and does not breed there.
- **(V) Vagrant:**
  Park is outside of the species usual range.
- **(UNK) Unknown:**
  Residency status in park is unknown.

California Myotis *Myotis californicus* Present SR?,PH,CL R UNK

This species was captured along Bridge Creek in the Painted Hills Unit and Pine Creek adjacent to the Clarno Unit. The species is likely to occur in the Sheep Rock Unit but was not detected during the inventory. No lactating females were captured. This species has recently been assigned a vulnerable" status by the Oregon Natural Heritage Program.

Western Small-footed Myotis *Myotis ciliolabrum* Present SR,PH?,CL C B

The western small-footed myotis was captured along the John Day River near Goose Rock, in the Sheep Rock Unit, and at an upland cave near Blue Basin and along Pine Creek adjacent to the Clarno Unit. Telemetry results on this species led to the discovery of many roost sites in and near the Clarno Unit, including the Palisades cliffs. This species has federal and state status as a "species of concern".

Long-eared Myotis *Myotis evotis* Present SR?,PH?,CL R UNK

One juvenile male was captured along Pine Creek adjacent to the Clarno Unit in 2002. No calls recorded with *Anabat* were positively identified to have come from this species, although several possible calls were recorded. The species was not detected in 2003 and it is probably occurs only sporadically in the monument. This species has federal and state status as a "species of concern".

Little Brown Myotis *Myotis lucifugus* Present SR,PH,CL C B

This species was captured along Rock Creek and the John Day River in the Sheep Rock Unit, Bridge Creek, and Pine Creek. Two maternity roosts were located in buildings in the Sheep Rock Unit.

Fringed Myotis *Myotis thysanodes* Present SR R UNK

One juvenile male was captured along Rock Creek in the Sheep Rock Unit in 2002. Another juvenile was encountered along the John Day River at Goose Rock in 2003. Two individuals flying over field #2 along the John Day River near the mouth of Rock Creek were positively identified to this species based on *Anabat* recordings. The species probably occurs only sporadically in the monument. This species has federal and state status as a "species of concern".

Long-legged Myotis *Myotis volans* Present SR,PH,CL U UNK

Several adult males of this species were captured along Bridge Creek in the Painted Hills Unit and Pine Creek adjacent to the Clarno Unit. One individual was captured along the John Day River at Cathedral Rock in 2003. This species probably only occurs sporadically in the monument. This species has federal and state status as a "species of concern".

Yuma Myotis *Myotis yumanensis* Present SR,PH,CL A B

This was the most common bat species captured and recorded in the monument. The species was found along the John Day River and its tributaries. One large maternity colony is located under the Clarno Bridge, several miles west of the Clarno Unit. Other maternity colonies are likely to be located on or near all three units. This species has federal status as a "species of concern".

Hoary Bat *Lasiurus cinereus* Present SR,PH,CL U M

Several adult males were captured along the John Day River, Rock Creek, Pine Creek, Bridge Creek, and the reservoir adjacent to the Painted Hills Unit. In 2003 females were captured along the John Day River, Pine Creek, and at the confluence of the north fork at Kimberly, Oregon.

Silver-haired Bat *Lasionycteris noctivagans* Present SR,PH,CL U UNK

Both sexes of this species were captured along Rock Creek, Bridge Creek, and Pine Creek. Radio telemetry results were inconclusive but suggest that the species is migratory through the monument area. This species has federal status as a "species of concern" and state status as "threatened".

Western Pipistrelle *Pipistrellus hesperus* Present SR,PH,CL A B

Western pipistrelles were captured and recorded along the John Day River in the Sheep Rock Unit and Pine Creek adjacent to the Clarno Unit. The species was also recorded along Bridge Creek in the Painted Hills Unit. Lactating females and newly volant young were among those individuals captured.

Big Brown Bat *Eptesicus fuscus* Present SR,PH,CL U UNK

Both sexes of this species were captured along Rock Creek in the Sheep Rock Unit and Pine Creek adjacent to the Clarno Unit. The species was recorded in the Painted Hills Unit. The species likely rears young in the area but this has not been confirmed.

Spotted Bat *Euderma maculatum* Present SR,PH,CL U UNK

The spotted bat was recorded along Pine Creek adjacent to the Clarno Unit as well as at the cliffs along the John Day River at Clarno, several miles from the Clarno Unit. Two individuals were captured there as well. One individual was captured in an upland cave near Blue Basin in the Sheep Rock Unit. The species' audible calls were heard over Hancock Field Station in the Clarno Unit, along Bridge Creek in the Painted Hills Unit, and at Cathedral Rock in the Sheep Rock Unit. This species was the most exciting and unusual confirmation during the 2002-2003 inventory, as it is little known in Oregon and has been referred to as North America's rarest mammal (Verts and Carraway 1998).

Townsend's Big-eared Bat *Corynrhinus townsendii* Present SR,PH?,CL R B

A colony of females, males, and was documented in 2002 and 2003 at an upland cave near Blue Basin in the Sheep Rock Unit. One additional lactating female was captured along Pine Creek adjacent to the Clarno Unit. This species has federal and state status as a "species of concern".

Pallid Bat *Antrozous pallidus* Present SR,PH,CL A B

This species was captured along the John Day River, Bridge Creek, and Pine Creek, and was recorded along Bridge Creek in the Painted Hills Unit. The species was notably absent along Rock Creek. Large maternity colonies of this species were located in the Palisades cliffs, at Goose Rock, and at the rimrock overlooking Bridge Creek in 2003. This species has state status as a "species of concern".

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Tables

Table 1. Bat mist net and "H" net capture locations in the John Day Fossil Beds National Monument during 2002 and 2003.

Session#	Date	UTMX	UTMY	Legal Description	Location
mist01SR	5/30/02	290780	4933700	T12S.R26E.Sec.18 SE1/4 NE1/16	Rock Cr. Bridge
mist02SR	6/1/02	290675	4933598	T12S.R26E.Sec.18 SE1/4 NE1/16	Rock Cr. Impoundment
mist03SR	6/2/02	290113	4939115	T11S.R12E.Sec.31 NW1/4 NE1/16	Goose Rock
mist04CL	6/11/02	703386	4977362	T7S.R19E.Sec.26 SW1/4 SW1/16	1st Stock Pond
mist05CL	6/12/02	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist06SR	6/25/02	290675	4933598	T12S.R26E.Sec.18 SE1/4 NE1/16	Rock Cr. Impoundment
mist07SR	6/26/02	290113	4939115	T11S.R12E.Sec.31 NW1/4 NE1/16	Goose Rock
mist08CL	7/15/02	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist09CL	7/16/02	703725	4977700	T7S.R19E.Sec.26 SW1/4 SW1/16	2nd Stock Pond
misc14CL	7/17/02	699800	4976470	T7S.R19E.Sec.32 NE1/4 SW1/16	Clarno Bridge
mist10CL	7/17/02	699750	4976725	T7S.R19E.Sec.32 NE1/4 SW1/16	JD River-below Clarno
mist11PH	7/22/02	718039	4948023	T10S.R21E.Sec.31 SE1/4 NW1/16	Picnic Area
mist12PH	7/23/02	716000	4949000	T10S.R20E.Sec.36 NW1/4 NE1/16	Reservoir
mist13PH	7/24/02	718039	4948023	T10S.R21E.Sec.31 SE1/4 NW1/16	Picnic Area
mist14SR	7/31/02	290780	4933700	T12S.R26E.Sec.18 SE1/4 NE1/16	Rock Cr. Bridge
mist15SR	8/1/02	290675	4933598	T12S.R26E.Sec.18 SE1/4 NE1/16	Rock Cr. Impoundment
mist16SR	8/5/02	290556	4934514	T12S.R26E.Sec.7 SE1/4 NE1/16	Lower Field#2
misc15CL	8/6/02	699800	4976470	T7S.R19E.Sec.32 NE1/4 SW1/16	Clarno Bridge
mist17SR	8/7/02	290556	4934514	T12S.R26E.Sec.7 SE1/4 NE1/16	Lower Field#2
mist18SR	8/8/02			Restricted Access	Cave
misc16SR	8/9/02	290140	4947425	T11S.R26E.Sec.6 NW1/4 NE1/16	Foree Shed
mist19CL	8/17/02	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist20PH	8/19/02	718039	4948023	T10S.R21E.Sec.31 SE1/4 NW1/16	Picnic Area
mist21CL	8/24/02	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist22CL	8/26/02	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist23PH	9/4/02	718039	4948023	T10S.R21E.Sec.31 SE1/4 NW1/16	Picnic Area
mist24SR	9/5/02	289857	4938723	T11S.R12E.Sec.31 NW1/4 NE1/16	Little Goose Rock
mist25SR	9/9/02	289857	4938723	T11S.R12E.Sec.31 NW1/4 SE1/16	Little Goose Rock
mist26CL	6/16/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist27CL	6/17/03	702351	4975961	T7S.R19E.Sec.34 SW1/4 SW1/4	Clarno Beaver Ponds
mist28CL	6/19/03	703725	4977700	T7S.R19E.Sec.26 SW1/4 SW1/16	2nd Stock Pond
mist29PH	6/22/03	718039	4948023	T10S.R21E.Sec.31 SE1/4 NW1/16	Picnic Area
mist30PH	6/26/03	718039	4948023	T10S.R21E.Sec.31 SE1/4 NW1/16	Picnic Area
mist31SR	6/28/30	290113	4939115	T11S.R12E.Sec.31 NW1/4 NE1/16	Goose Rock
mist32SR	7/1/03	290675	4933598	T12S.R26E.Sec.18 SE1/4 NE1/16	Rock Cr. Impoundment
mist33CL	7/3/03	699950	4976300	T7S.R19E.Sec.32 SE1/4 NE1/4	Clarno Cliffs
mist34CLa	7/4/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist34CLb	7/4/03	699950	4976300	T7S.R19E.Sec.32 SE1/4 NE1/4	Clarno Cliffs
mist35SR	7/5/03	290440	4945115	T11S.R26E.Sec.7 NW1/4 SE1/4	Cathedral Rock
mist36SR	7/6/03	289857	4938723	T11S.R12E.Sec.31 NW1/4 SE1/16	Little Goose Rock
mist37CL	7/7/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist38SR	7/8/03	290440	4945115	T11S.R26E.Sec.7 NW1/4 SE1/4	Cathedral Rock

Session#	Date	UTMX	UTMY	Legal Description	Location
mist39SR	7/9/03	290113	4939115	T11S.R12E.Sec.31 NW1/4 NE1/16	Goose Rock
mist40CL	7/9/03	703725	4977700	T7S.R19E.Sec.26 SW1/4 SW1/16	2nd Stock Pond
mist41CL	7/14/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist42CL	7/16/03	702351	4975961	T7S.R19E.Sec.34 SW1/4 SW1/4	Clarno Beaver Ponds
mist43CL	7/17/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist44SR	7/19/03	290113	4939115	T11S.R12E.Sec.31 NW1/4 NE1/16	Goose Rock
mist45CLa	7/23/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist45CLb	7/23/03	702351	4975961	T7S.R19E.Sec.34 SW1/4 SW1/4	Clarno Beaver Ponds
mist46CL	7/28/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist47PHa	7/29/03	718039	4948023	T10S.R21E.Sec.31 SE1/4 NW1/16	Picnic Area
mist47PHb	7/29/03	718039	4948023	T10S.R21E.Sec.31 SE1/4 NW1/16	Picnic Area
mist48SR	7/30/03	289857	4938723	T11S.R12E.Sec.31 NW1/4 SE1/16	Little Goose Rock
mist49CLa	8/2/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist49CLb	8/2/03	700375	4975600	T8S.R19E.Sec.4 NW1/4 NW1/4	Lower Perkins Rd.
mist50SR	8/3/03	291250	4959000	T9S.R26E.Sec.30 SW1/4 SE1/4	N. Fork/Kimberly
mist51CL	8/4/03	700375	4975600	T8S.R19E.Sec.4 NW1/4 NW1/4	Lower Perkins Rd.
mist52CL	8/5/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist53CL	8/15/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist54CLa	8/16/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist54CLb	8/16/03	700375	4975600	T8S.R19E.Sec.4 NW1/4 NW1/4	Lower Perkins Rd.
mist55CL	8/18/03	703270	4977046	T7S.R19E.Sec.34 NE1/4 SW1/4	Hancock Field Station
mist56SR	8/19/03	290440	4945115	T11S.R26E.Sec.7 NW1/4 SE1/4	Cathedral Rock
mist57CLa	8/21/03	702351	4975961	T7S.R19E.Sec.34 SW1/4 SW1/4	Clarno Beaver Ponds
mist57CLb	8/21/03	700375	4975600	T8S.R19E.Sec.4 NW1/4 NW1/4	Lower Perkins Rd.
mist58CL	8/25/03	699950	4976300	T7S.R19E.Sec.32 SE1/4 NE1/4	Clarno Cliffs
mist59CLa	8/27/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist59CLb	8/27/03	699950	4976300	T7S.R19E.Sec.32 SE1/4 NE1/4	Clarno Cliffs
mist60CL	8/31/03	702351	4975961	T7S.R19E.Sec.34 SW1/4 SW1/4	Clarno Beaver Ponds
mist61CLa	9/1/03	702351	4975961	T7S.R19E.Sec.34 SW1/4 SW1/4	Clarno Beaver Ponds
mist61CLb	9/1/03	700375	4975600	T8S.R19E.Sec.4 NW1/4 NW1/4	Lower Perkins Rd.
mist62SR	9/3/03	290113	4939115	T11S.R12E.Sec.31 NW1/4 NE1/16	Goose Rock
mist63CL	9/11/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist64CL	9/12/03	702351	4975961	T7S.R19E.Sec.34 SW1/4 SW1/4	Clarno Beaver Ponds
mist65CLa	9/14/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist65CLb	9/14/03	699950	4976300	T7S.R19E.Sec.32 SE1/4 NE1/4	Clarno Cliffs
mist66SR	9/15/03			Restricted Access	Cave
mist67CLa	9/18/03	703965	4976114	T7S.R19E.Sec.35 SW1/4 SW1/16	Potter Place
mist67CLb	9/18/03	699950	4976300	T7S.R19E.Sec.32 SE1/4 NE1/4	Clarno Cliffs
mist68CL	9/21/03	699950	4976300	T7S.R19E.Sec.32 SE1/4 NE1/4	Clarno Cliffs
mist69CL	9/24/03	699950	4976300	T7S.R19E.Sec.32 SE1/4 NE1/4	Clarno Cliffs
mist70SR	9/28/30			Restricted Access	Cave
mist71CL	10/3/03	699950	4976300	T7S.R19E.Sec.32 SE1/4 NE1/4	Clarno Cliffs

[a] The two-letter codes following the session number refer to the monument unit:
SR – Sheep Rock; CL – Clarno; PH – Painted

Table 2. Bat capture results and relative abundance from the mist net and hand capture sessions during 2002 in the John Day Fossil Beds National Monument.

	Species[a]														
Session#	**YU/LU**	**MYLU**	**MYYU**	**MYCI**	**MYVO**	**MYCA**	**MYTH**	**MYEV**	**ANPA**	**COTO**	**PIHE**	**LANO**	**LACI**	**EPFU**	**EUMA**	**Total**
mist01SR	1															**1**
mist02SR	9															**9**
mist03SR	2								3							**5**
mist04CL																**0**
mist05CL	2								1			2				**5**
mist06SR	11											3		1		**15**
mist07SR	23															**23**
mist08CL		1	3			1			7		5			3		**20**
mist09CL					1						6					**7**
misc14CL			9													**9**
mist10CL	1															**1**
mist11PH			1									1	1			**3**
mist12PH	2												1			**3**
mist13PH						1							1			**2**
mist14SR		2	1								1					**4**
mist15SR		1	24				1						1			**27**
mist16SR		2	1													**3**
misc15CL			6													**6**
mist17SR																**0**
mist18SR				3					2	2						**7**
misc16SR		2														**2**
mist19CL			2		1				9	1	3					**16**
mist20PH					1											**1**
mist21CL			1	5	1	1		1	2		5			1		**17**
mist22CL			1								1	1				**3**
mist23PH																**0**
mist24SR			1	1												**2**
mist25SR		1	1													**2**
mist26CL		1	1	1							1	1		1		**6**
mist27CL		1	4									3				**8**
mist28CL									3							**3**
mist29PH			1			1			1							**3**
mist30PH		2	4									2				**8**
mist31SR	1	2	3						5			1		1		**13**
mist32SR		1	3	1							1		1			**7**
mist33CL																**0**
mist34CLa			1						1		3					**5**
mist34CLb																**0**
mist35SR		6										1	1			**8**

Session#	YU/LU	MYLU	MYYU	MYCI	MYVO	MYCA	MYTH	MYEV	ANPA	COTO	PIHE	LANO	LACI	EPFU	EUMA	Total
mist36SR	1	5														**6**
mist37CL		6	1						2		2	1	1			**13**
mist38SR	3															**3**
mist39SR	1		1													**2**
mist40CL		1							2							**3**
mist41CL			2						3				1			**6**
mist42CL		6									2			1		**9**
mist43CL				1					5		2		1			**9**
mist44SR	4	4							4							**12**
mist45CLa		4	2						12		2		1			**21**
mist45CLb	1	8							3				1			**13**
mist46CL			2						4		4					**10**
mist47PHa									3							**3**
mist47PHb																**0**
mist48SR	18	6					1		1							**26**
mist49CLa		1	2	1					2		3					**9**
mist49CLb		4	1													**5**
mist50SR	17	9											1			**27**
mist51CL		1														**1**
mist52CL		2	2						1		3					**8**
mist53CL		2	2													**4**
mist54CLa			1													**1**
mist54CLb																**0**
mist55CL		1	1	1								1				**4**
mist56SR	3	3	1	1												**8**
mist57CLa		3	2						1		1	2	5	1		**15**
mist57CLb		2														**2**
mist58CL																**0**
mist59CLa		4		1							1					**6**
mist59CLb									2						1	**3**
mist60CL		2										2				**4**
mist61CLa		1														**1**
mist61CLb	4	7														**11**
mist62SR	3	1							5			2	1			**12**
mist63CL		1														**1**
mist64CL		3	1		2											**6**
mist65CLa			1													**1**
mist65CLb																**0**
mist66SR			2						3	24					1	**30**
mist67CLa		3	3	1					1		4	2	1			**15**
mist67CLb													1			**1**
mist68CL																**0**
mist69CL															1	**1**
mist70SR			10							16				2		**28**
mist71CL												1				**1**

Session#	YU/LU	MYLU	MYYU	MYCI	MYVO	MYCA	MYTH	MYEV	ANPA	COTO	PIHE	LANO	LACI	EPFU	EUMA	Total
Total	**52**	**77**	**158**	**48**	**10**	**6**	**2**	**1**	**88**	**43**	**50**	**26**	**20**	**11**	**3**	**595**
Relative Abundance	**0.09**	**0.13**	**0.27**	**0.08**	**0.02**	**0.01**	**0.003**	**0.002**	**0.15**	**0.07**	**0.08**	**0.04**	**0.03**	**0.02**	**0.005**	

[a] YU/LU – Undifferentiated *Myotis yumanensis*/ *Myotis lucifugus*
MYLU – *Myotis lucifugus*
MYYU – *Myotis yumanensis*
MYCI – *Myotis ciliolabrum*
MYVO – *Myotis volans*
MYCA - *Myotic califonricus*
MYTH – *Myotis thysanodes*
MYEV – *Myotis evotis*
ANPA – *Antrozous pallidus*
COTO – *Corynorhinus townsendii*
PIHE - *Pipistrellus hesperus*
LANO – *Lasionycteris noctivagans*
LACI – *Lasiurus cinereus*
EPFU – *Eptesicus fuscus*
EUMA-*Euderma maculatum*

Table 3. Pallid bat roost locations from 2003 in the John Day Fossil Beds National Monument.

Bat ID	Date	UTMX	UTMY	Height	Aspect
ANPA569	030623	717396	4948277	8	95
ANPA569	030624	717396	4948277	8	95
ANPA569	030627	717373	4948197	8	115
ANPA569	030701	717419	4948399	2.5	170
ANPA569	030708	717473	4948502	4	42
ANPA635	030629	290202	4939101	45	268
ANPA635	030630	290202	4939101	45	268
ANPA635	030701	290202	4939101	45	268
ANPA635	030702	290213	4939131	62	246
ANPA635	030703	290213	4939131	62	246
ANPA635	030704	290213	4939131	62	246
ANPA645	030708	703985	4976289	8	180
ANPA645	030709	703996	4976282	11	254
ANPA645	030710	703996	4976282	11	254
ANPA645	030714	703892	4976344	12	154
ANPA645	030715	703892	4976344	12	154
ANPA645	030722	703892	4976344	12	154
ANPA686	030720	290220	4939025	15	324
ANPA686	030722	290225	4939025	30	220
ANPA695	030710	703996	4976282	11	254
ANPA695	030714	703996	4976282	11	254
ANPA695	030715	704015	4976262	30	122
ANPA695	030717	703831	4976317	6	180
ANPA695	030722	703996	4976282	11	254
ANPA717	030730	717661	4948513	6	310
ANPA717	030731	717473	4948502	7	150
ANPA805	030904	Inaccessible			
ANPA805	030905	290831	4947973		180
ANPA805	030906	290860	4947973		180
ANPA805	030908	290800	4947973		180
ANPA833	030904	Inaccessible			
ANPA833	030905	287382	4933793	1.5	198
ANPA833	030906	287360	4933956	2	40
ANPA833	030908	287342	4933899	1.5	100
ANPA882	030708	703985	4976289	8	180
ANPA882	030709	703996	4976282	11	254
ANPA882	030710	703996	4976282	11	254
ANPA882	030714	703892	4976344	12	154
ANPA882	030715	703892	4976344	12	154
ANPA898	030629	290202	4939101	45	268
ANPA898	030630	290202	4939101	45	268
ANPA898	030701	290202	4939101	45	268
ANPA898	030702	290213	4939131	62	246
ANPA898	030703	290213	4939131	62	246
ANPA898	030704	290213	4939131	62	246

Table 4. Western small-footed roost locations from 2003 in the Clarno Unit of the John Day Fossil Beds National Monument and the Pine Creek Ranch.

Bat ID	Date	UTMX	UTMY	Height	Aspect
MYCI500	030724	708118	4979061	7.00	250
MYCI500	030726	708118	4979061	7.0	250
MYCI500	030728	708298	4979076	2.5	300
MYCI540	030719	703929	4976364	8.0	276
MYCI540	030720	703920	4976389	2.0	240
MYCI540	030721	703923	4976377	8.0	280
MYCI540	030722	703929	4976359	8.0	200
MYCI540	030723	703846	4976335	4.0	10
MYCI540	030724	703921	4976375	8.0	340
MYCI540	030727	703923	4976375	8.0	180
MYCI581	030725	703774	4976300	20.0	270
MYCI581	030726	703774	4976300	20.0	220
MYCI581	030727	703689	4976242	2.5	180
MYCI581	030728	703785	4976315	20.0	120
MYCI581	030729	704229	4976349	2.5	94
MYCI581	030730	704192	4976315	35.0	200
MYCI581	030731	704250	4976390	7.0	336
MYCI581	030803	704244	4976350	6.0	155
MYCI581	030804	704236	4976363	3.0	20
MYCI622	030803	709310	4975984	0.5	190
MYCI622	030804	709281	4975984	0.5	140
MYCI622	030805	709281	4975984	0.5	140
MYCI622	030806	709168	4976161	0.5	210
MYCI622	030807	709352	4976007	1.0	290
MYCI622	030808	709352	4976007	1.0	290
MYCI622	030810	709168	4976154	1.0	128
MYCI661	030822	712294	4974775	0.5	285
MYCI661	030825	712262	4974844	5.0	120
MYCI661	030826	712135	4974853	6.0	220
MYCI661	030827	712100	4974832	2.0	225
MYCI661	030831	712460	4974819	0.0	220
MYCI661	030901	712549	4974742	0.5	172
MYCI661	030902	712328	4974754	0.5	60
MYCI699	030822	706982	4982293	2.5	330
MYCI699	030825	706882	4982270	2.0	180
MYCI699	030826	706923	4982288	2.0	150
MYCI699	030827	706867	4982279	5.0	160
MYCI741	030913	703733	4976467	3.0	214
MYCI741	030914	703665	4976488	5.0	186
MYCI741	030915	704245	4976359	0.5	290
MYCI741	030916	704245	4976359	0.5	290
MYCI741	030918	704245	4976359	0.5	290
MYCI741	030919	703747	4976472	3.5	218
MYCI741	030921	703747	4976472	3.5	218
MYCI741	030922	703553	4976513	5.0	280

Bat ID	Date	UTMX	UTMY	Height	Aspect
MYCI741	030924	703553	4976513	5.0	280
MYCI783	030922	704791	4973930	3.0	180
MYCI783	030924	704680	4974040	0.5	356
MYCI783	030925	704691	4973983	1.0	300
MYCI820	030922	705017	4974328	2.5	228
MYCI820	030924	705004	4974351	0.2	240
MYCI820	030925	705004	4974351	0.2	240

Table 5. Summary statistics for selected characteristics of pallid bat day roosts in the John Day Fossil Beds National Monument.

	Roost Ht. (m)	Aspect	Colony Size	Emergence Time	Dist. To Capture (km)	Days in Roost
Mean	24.8	202	54	49	0.41	2
Std. Dev.	21.3	67	40	12	0.47	1.8
Range	2.5-62 n=37	40-324 n=43	22-120 n=9	31-74 n=15	0.09-1.47 n=35	1-9 n=28

Table 6. Summary statistics for selected characteristics of western small-footed myotis day roosts in the John Day Fossil Beds National Monument.

	Roost Ht. (m)	Aspect	Colony Size	Emergence Time	Dist. to Capture (km)	Dist. to Foraging Area	Days in Roost
Mean	4.7	216	2	25	4.4	6	1.2
Std. Dev.	6.4	77	2.5	7	4.3	3.7	0.5
Range	0-35	10-340	1-15	8-35	0.3-10.5	3-12	1-3
	n=52	n=52	n=38	n=17	n=52	n=52	n=43

Table 7. Comparison of mean roost height, roost distance from capture location, and roost emergence times for pallid bats and western small-footed myotis in the John Day Fossil Beds National Monument.

	ANPA (X_2)	MYCI (X_1)	X_2-X_1	95% CI	p-value
Roost Height	24.8	4.7	20.1	16.5-31.3	<0.01
Roost Distance to Capture Site	0.41	4.4	3.99	2.5-5.4	<0.01
Emergence Time	49	25	24	16.5-31.3	<0.01

Figures

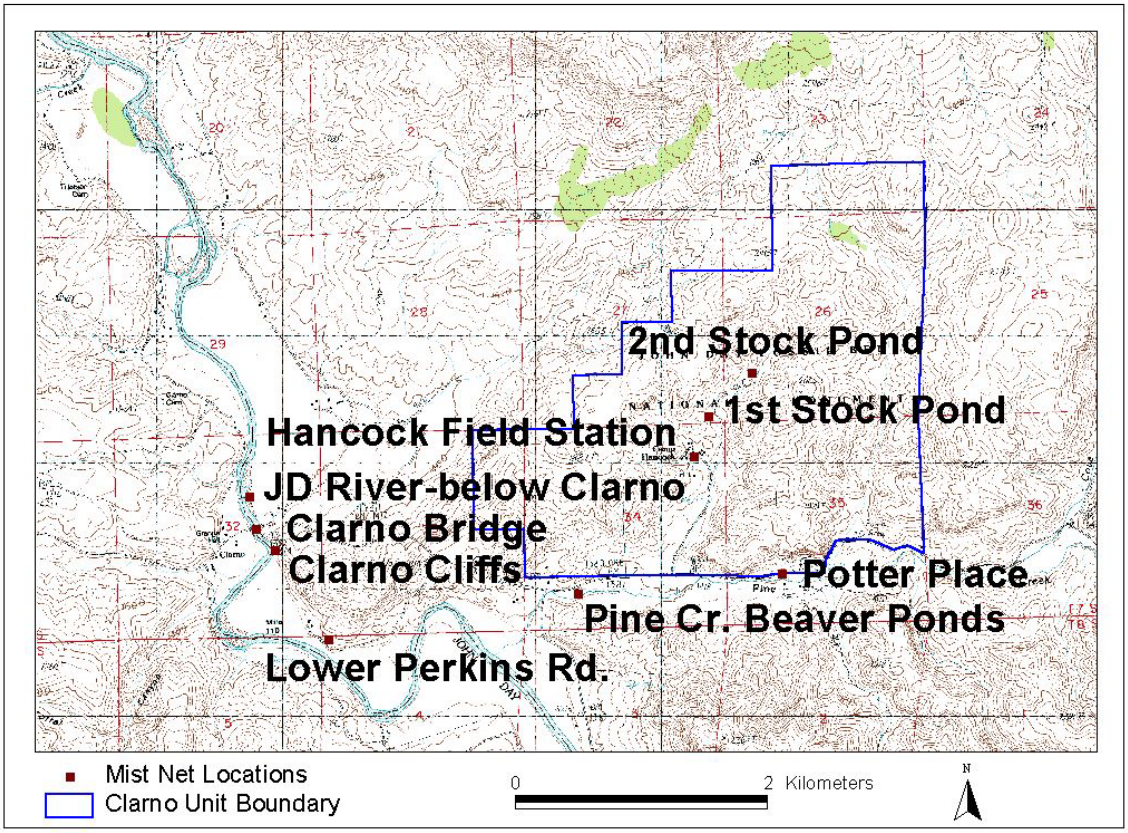

Figure 1. Bat mist net and "H"-net hand capture locations in and adjacent to the Clarno Unit of the John Day Fossil Beds National Monument.

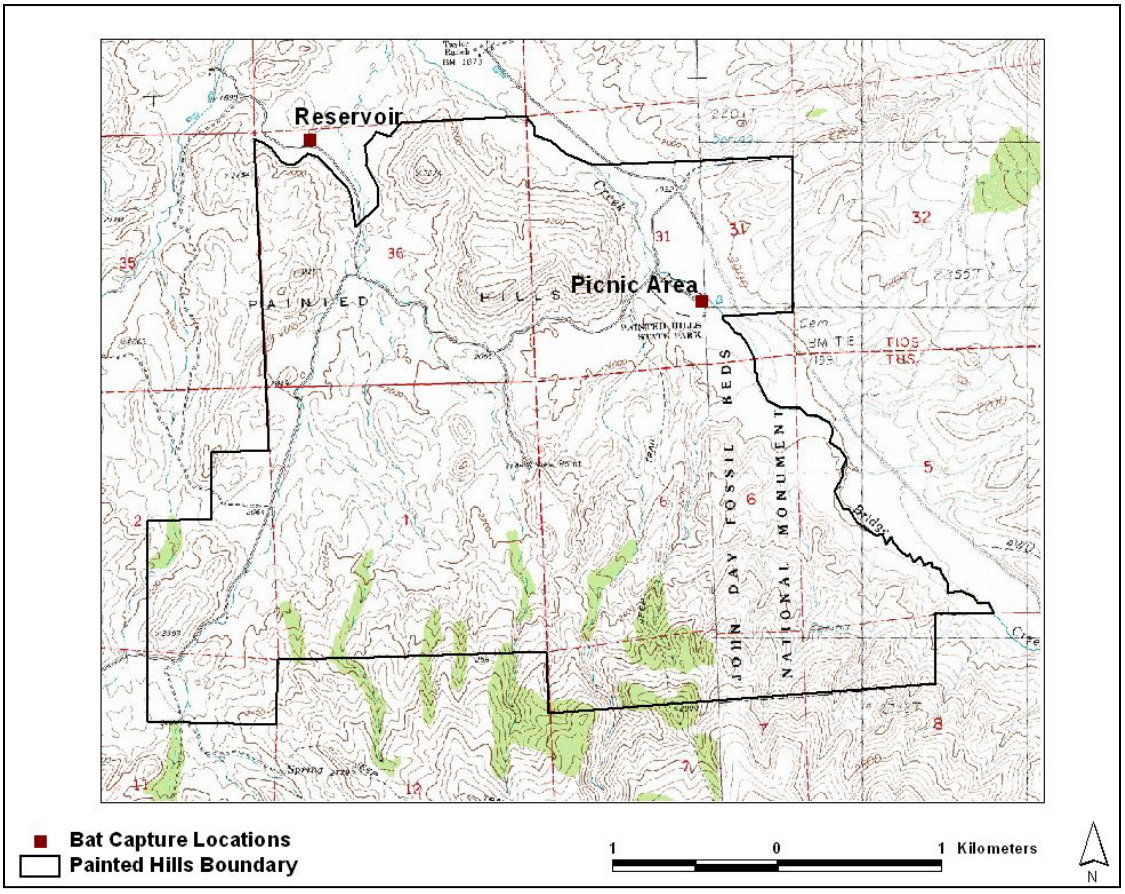

Figure 2. Bat mist net locations in the Painted Hills Unit of the John Day Fossil Beds National Monument.

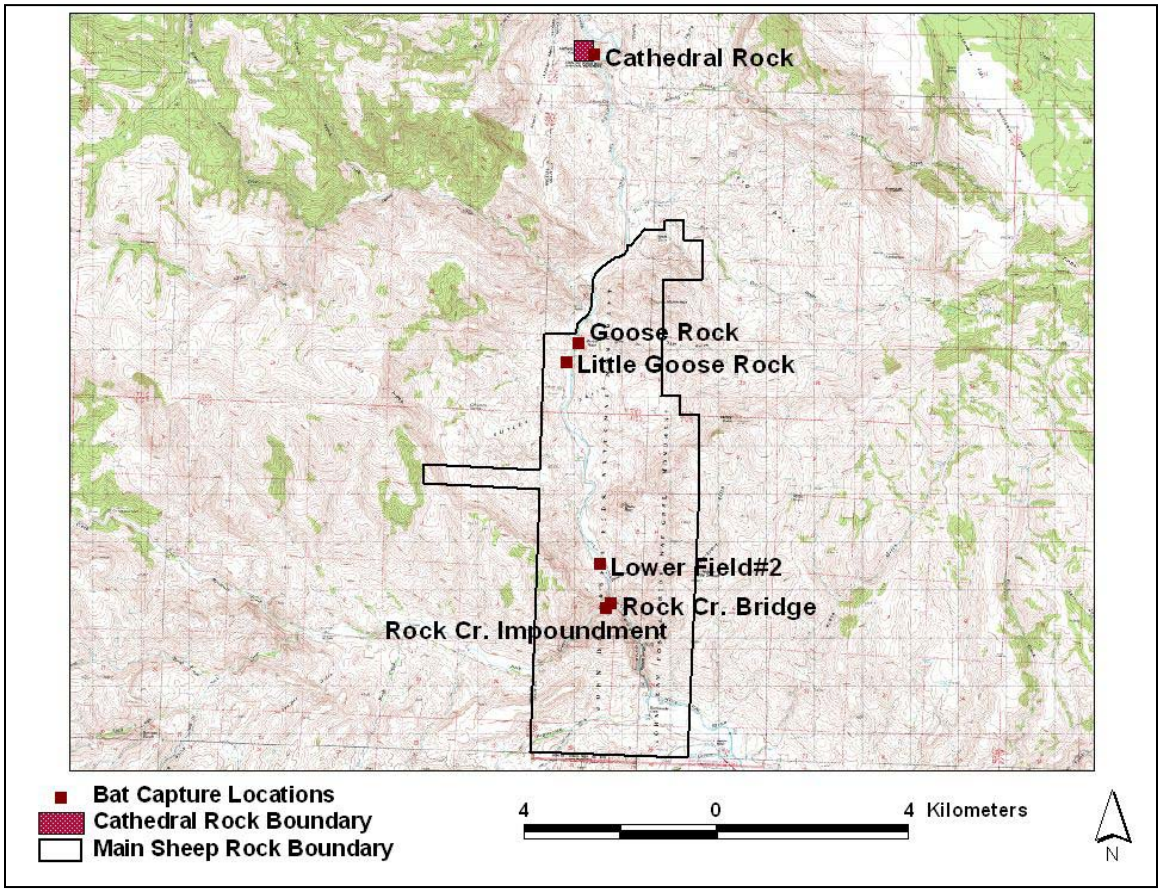

Figure 3. Bat mist net locations in the Sheep Rock portion of the Sheep Rock Unit in the John Day Fossil Beds National Monument.

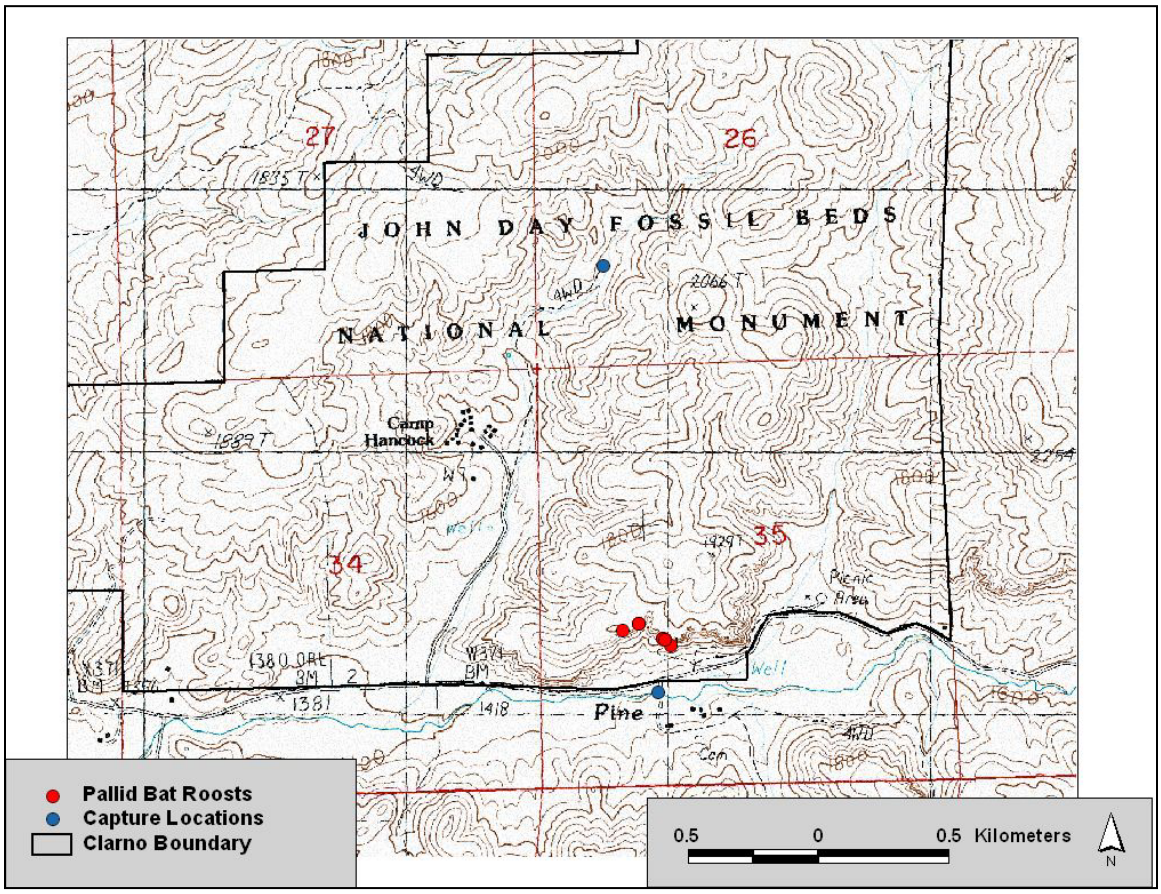

Figure 4. Day roost locations of female pallid bats in the Clarno Unit of the John Day Fossil Beds National Monument during 2003.

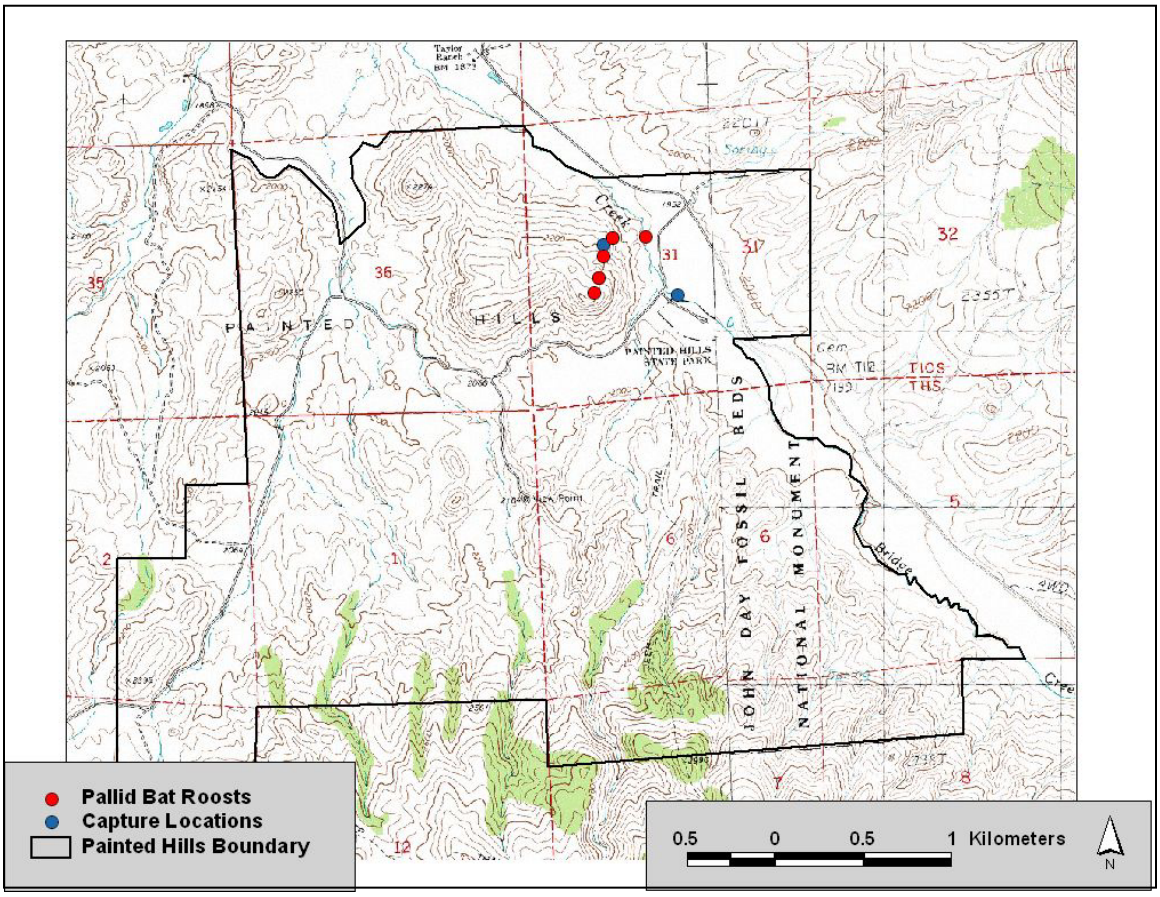

Figure 5. Day roost locations of female pallid bats in the Painted Hills Unit of the John Day Fossil Beds National Monument during 2003.

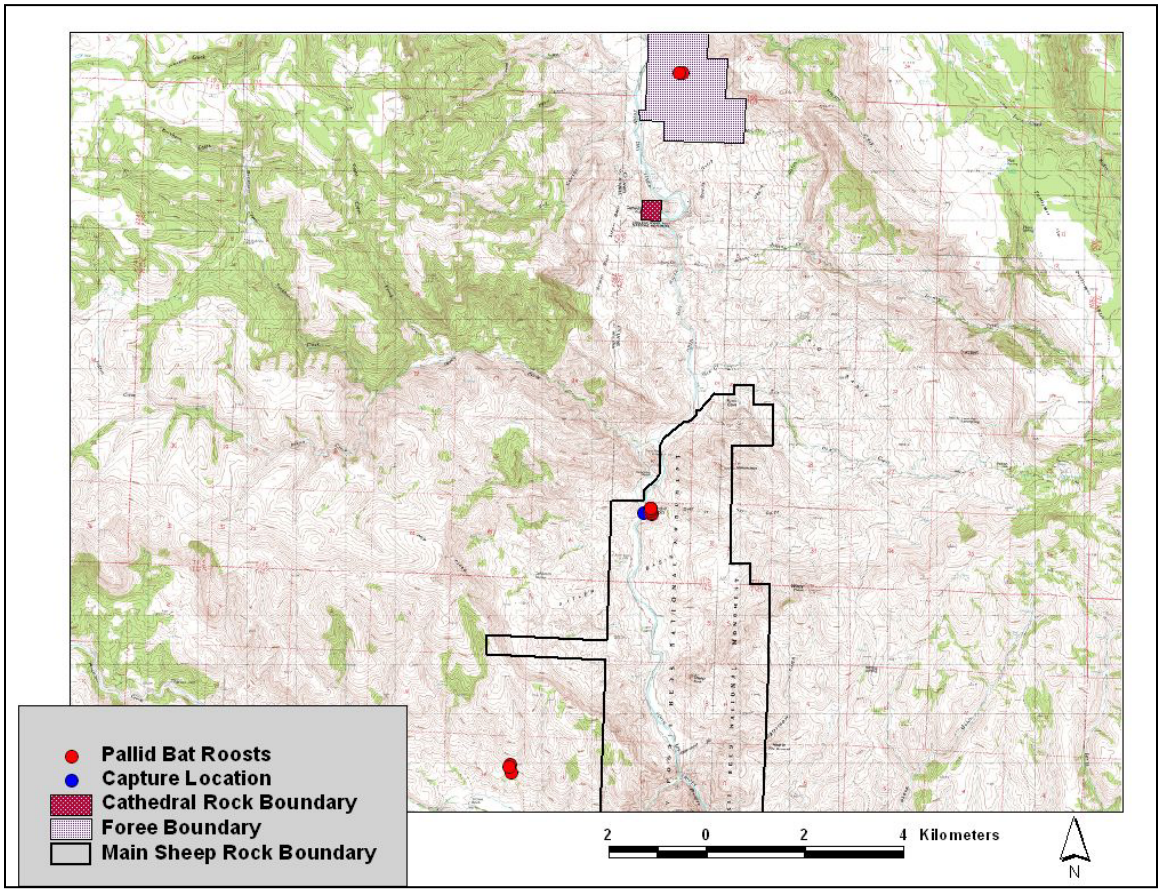

Figure 6. Day roost locations of female pallid bats in the Sheep Rock Unit of the John Day Fossil Beds National Monument.

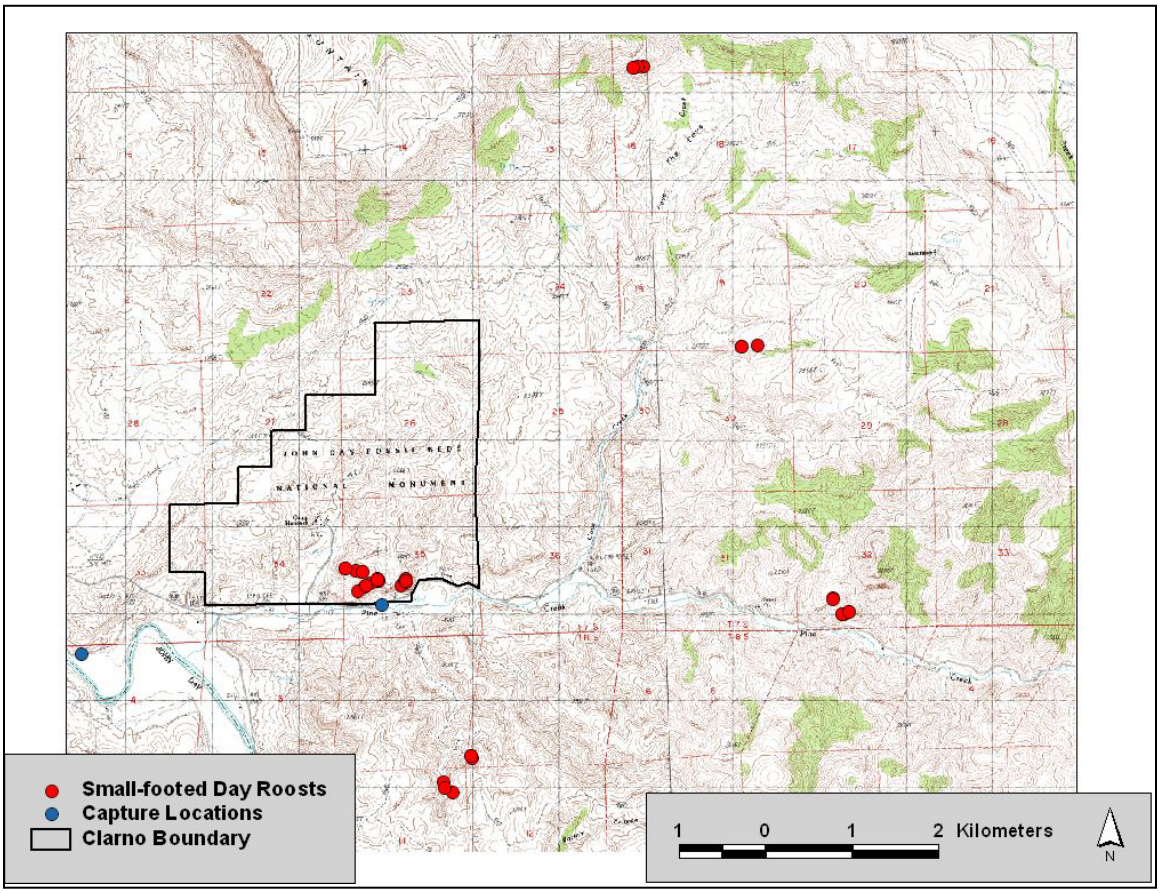

Figure 7. Day roost locations for 9 female western small-footed myotis in the John Day Fossil Beds National Monument and the Pine Creek Ranch during 2003.

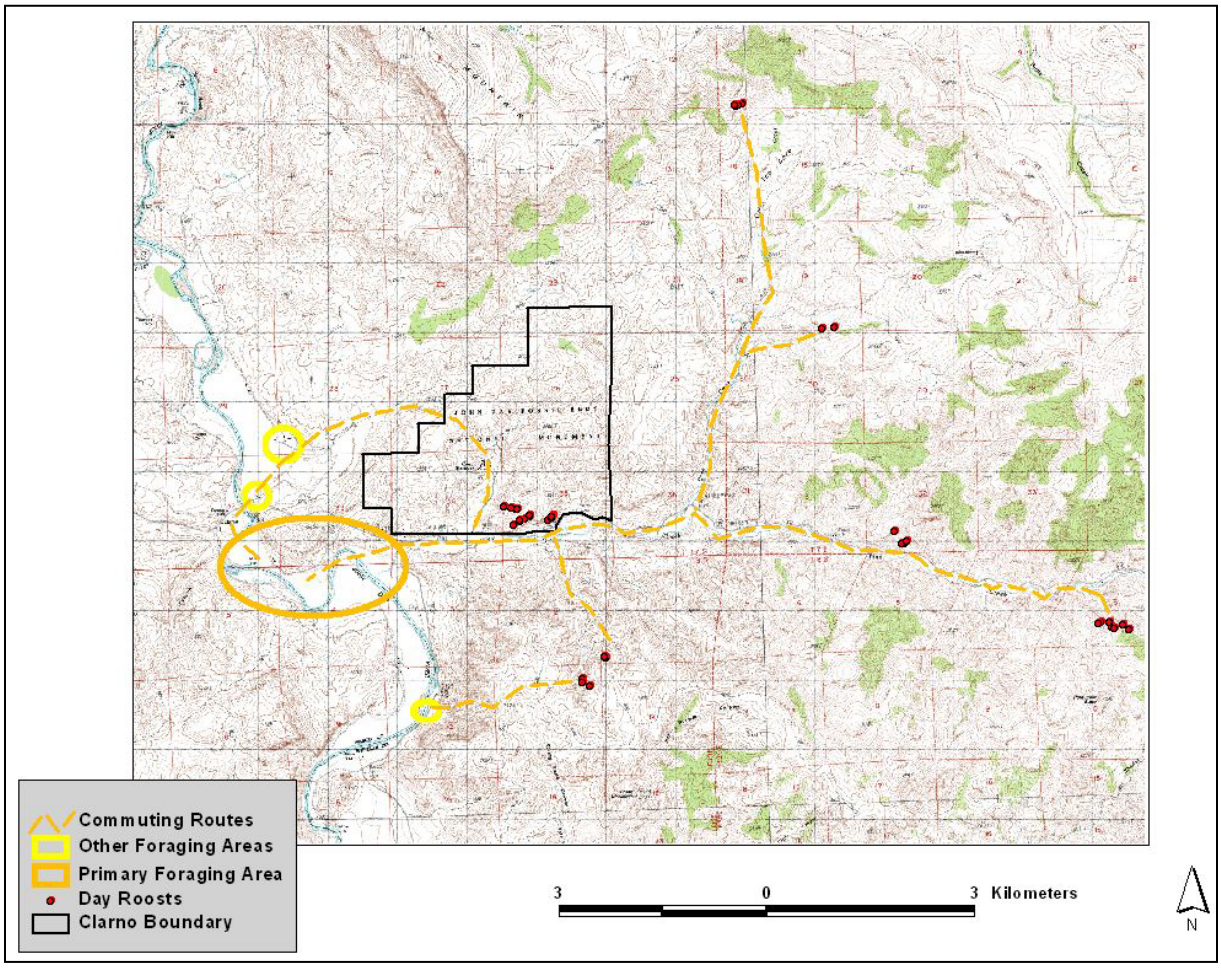

Figure 8. Foraging areas and commuting routes for female western small-footed myotis in the Clarno Basin based on 38 nights of observations.